US005353625A

United States Patent [19]

Hoshino et al.

[11] **Patent Number: 5,353,625**

[45] **Date of Patent: Oct. 11, 1994**

[54] **TERMINAL CRIMPING MACHINE**

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[73] Assignee: **Yazaki Corporation,** Tokyo, Japan

[21] Appl. No.: **139,827**

[22] Filed: **Oct. 22, 1993**

[30] **Foreign Application Priority Data**

Oct. 23, 1992 [JP] Japan 4-285933

[51] **Int. Cl.**[5] **H01R 43/048**

[52] **U.S. Cl.** **72/416;** 72/427; 72/461; 29/753

[58] **Field of Search** 72/416, 410, 461, 427; 29/753, 751

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Primary Examiner—Daniel C. Crane

Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas

[57] **ABSTRACT**

An object of the present invention is to provide a terminal crimping machine which assures that undesirable bending of a cable caused due to the fact that a terminal firmly fitted into a crimper is raised up together with the crimper after the time of terminal crimping is reduced as far as possible. A terminal crimping machine includes a crimper **3,** an anvil **4** located opposite to the crimper **1,** and a stopper **13** composed of a terminal disconnecting piece **14** and an arm piece **15,** and the arm piece **15** is turnably disposed on a guide frame **11** of the ram **2** to turn about a pin **12.** A tension spring **20** is bridged between the arm piece **15** and a spring fixing piece **19.** As the ram **2** is lowered, it comes in slidable contact with the arm piece **15** so as to allow the arm piece **15** assume an upright attitude. At this time, the terminal disconnecting piece **14** is located at the terminal disconnecting position higher than the anvil **4** by a predetermined distance. When the crimper **3** is raised up in excess of the terminal disconnecting position, the arm piece **14** is disengaged from the ram **2,** causing the stopper **13** to be turned to the crimper **3** side by the resilient power of the tension spring **20.** When the ram **2** reaches an upper dead point, an outer edge portion **16** of the stopper **13** is located inside of the lower end of the crimper **3.**

6 Claims, 8 Drawing Sheets

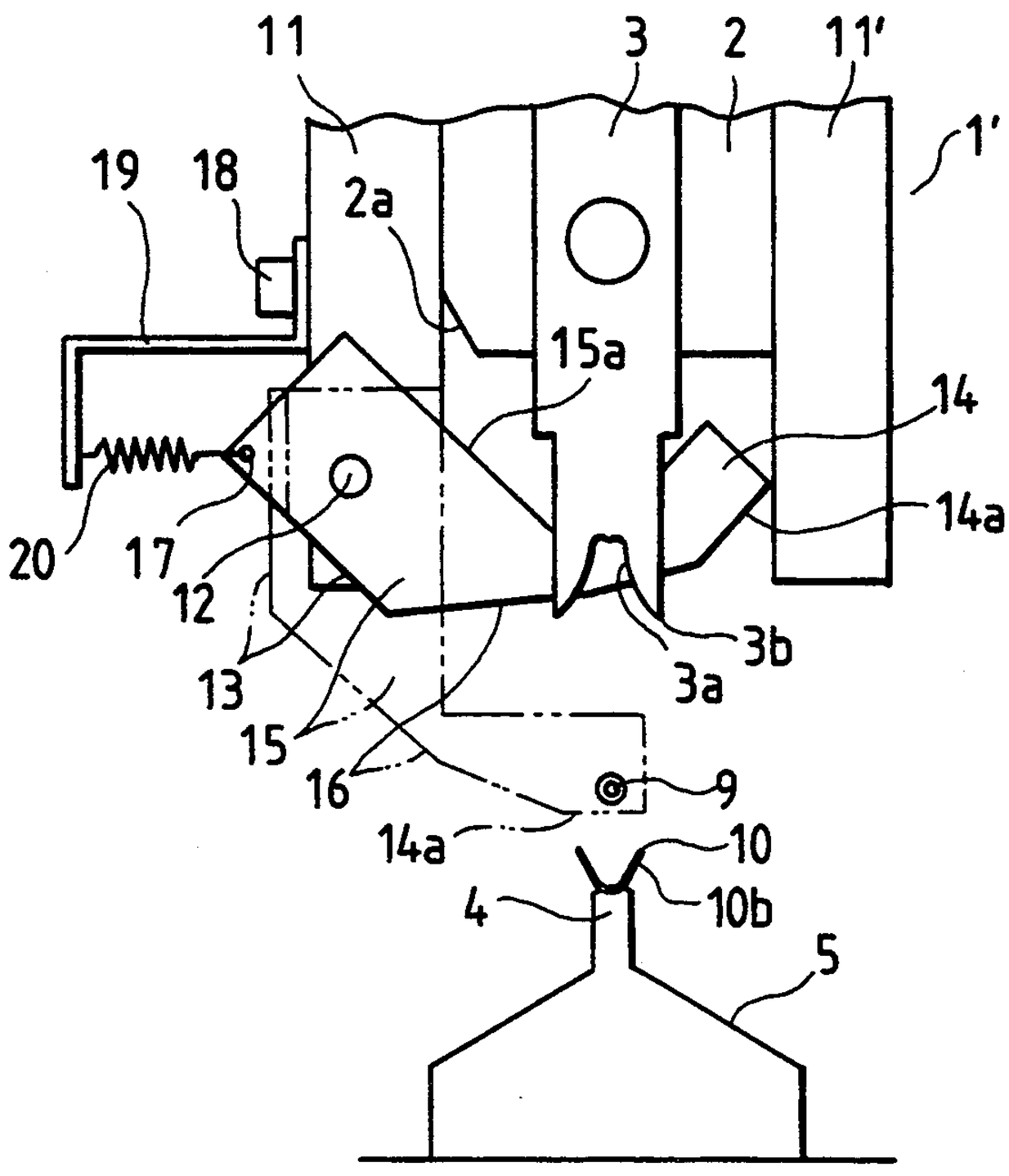


FIG. 1

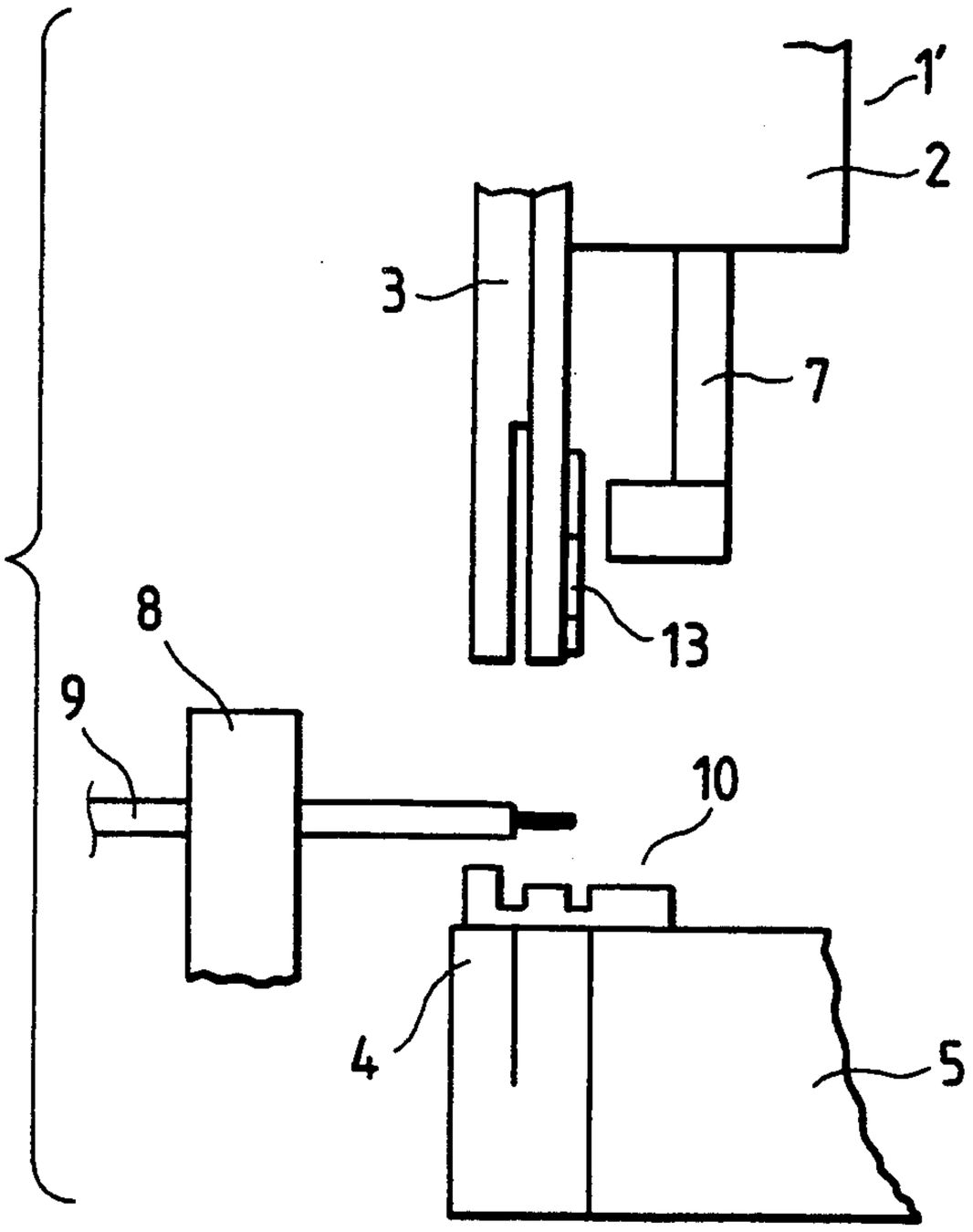

1'
2
3
7
13
8
9
10
4
5

FIG. 2

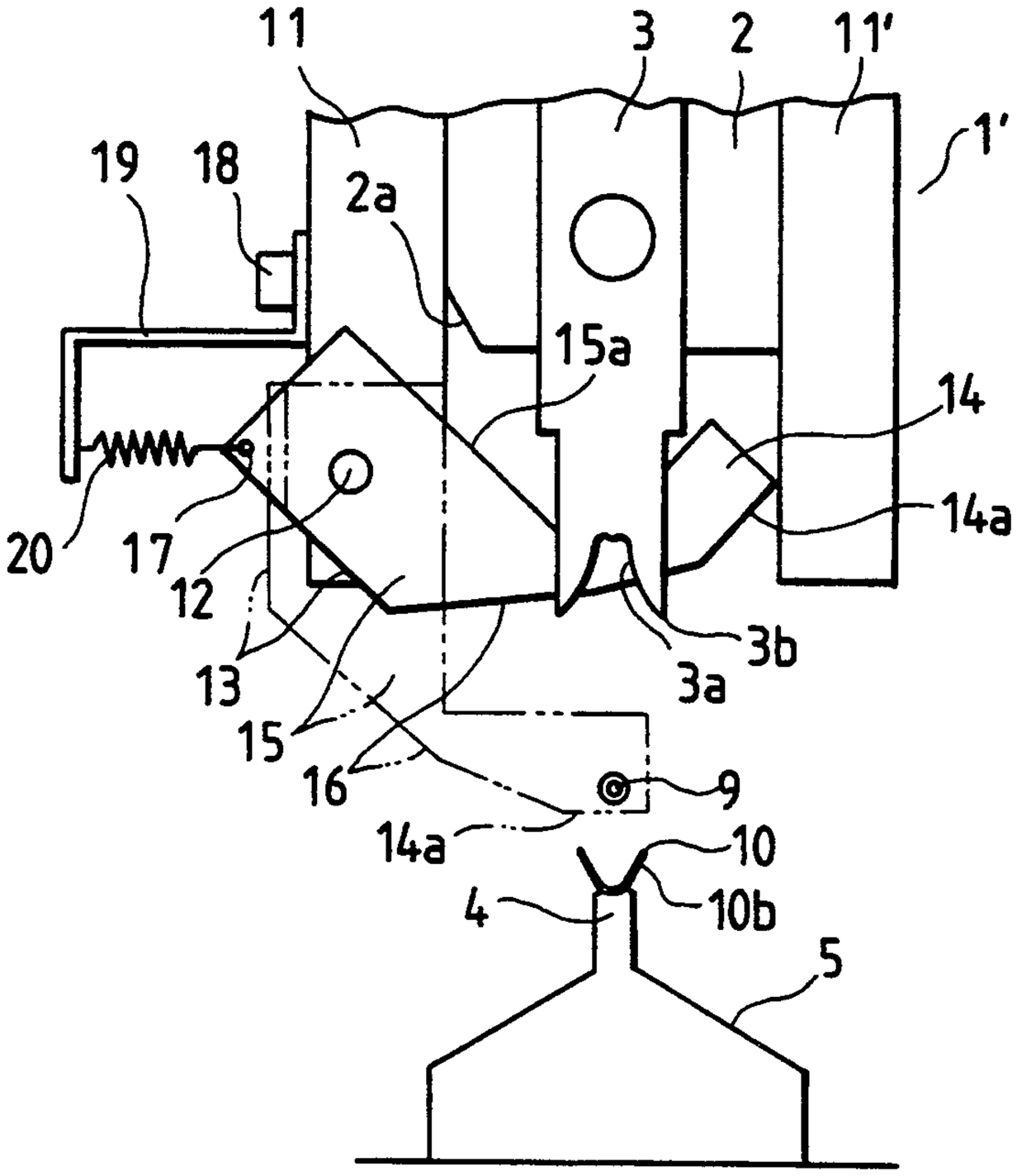

11
3
2
11'
1'
19
18
2a
15a
14
14a
20
17
12
13
3b
3a
15
16
9
14a
10
10b
4
5

FIG. 3(a)

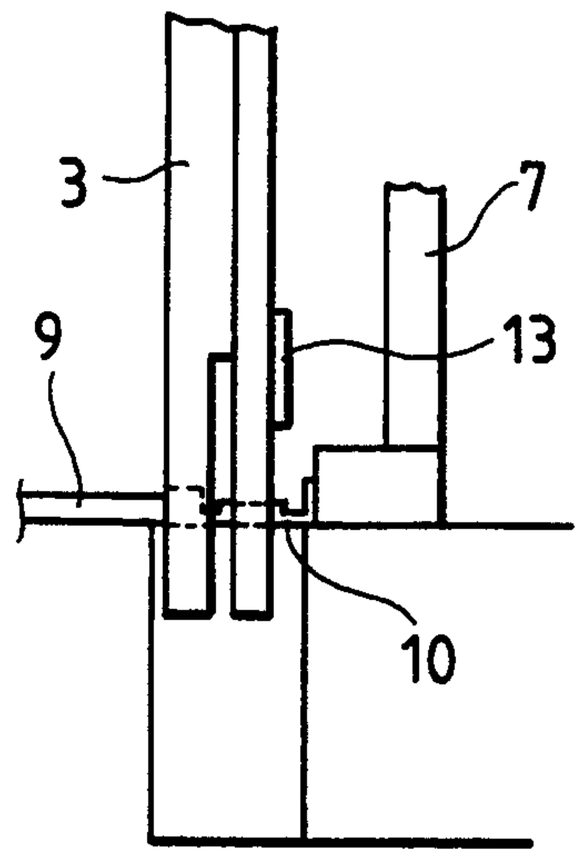


FIG. 3(b)

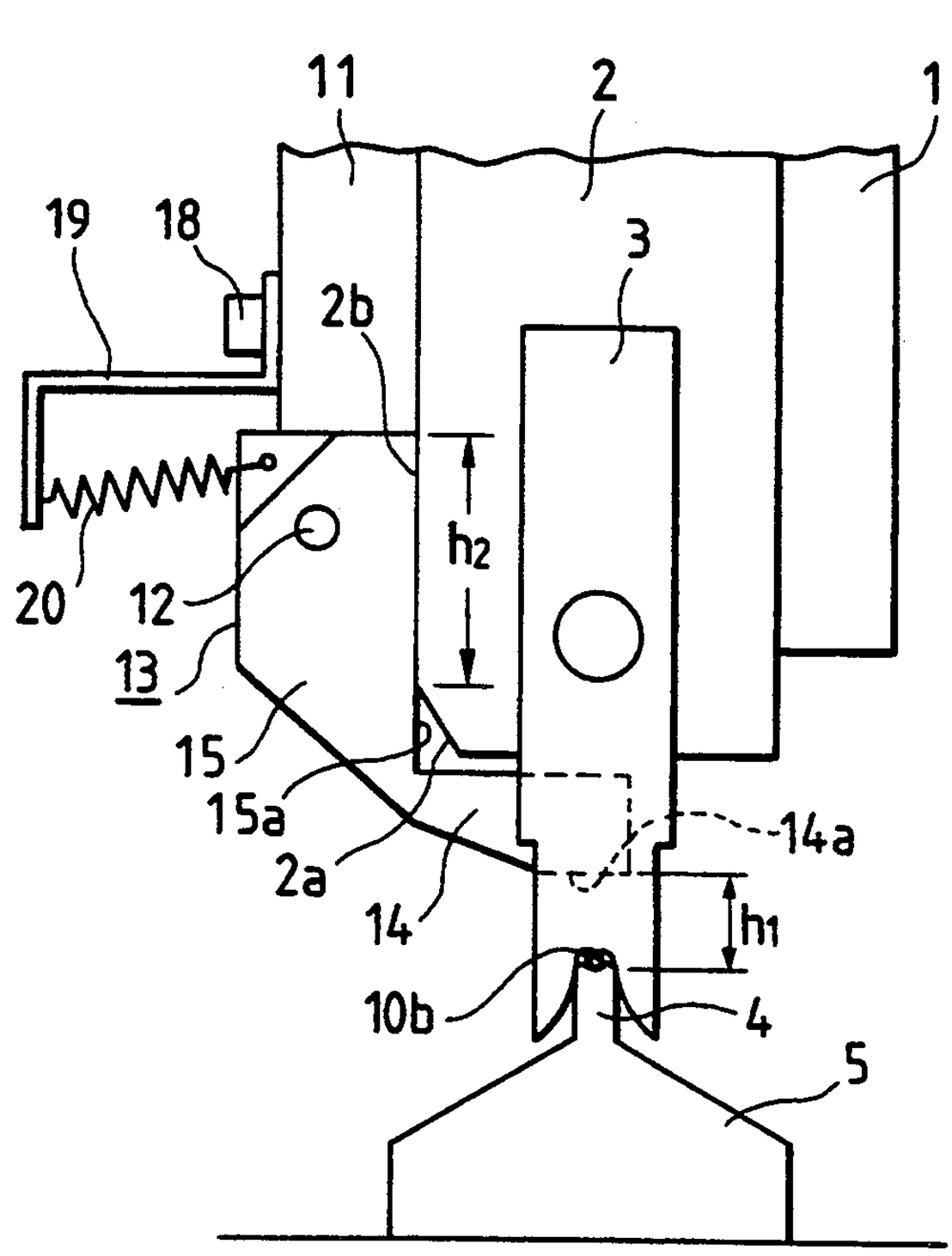


FIG. 4(a)

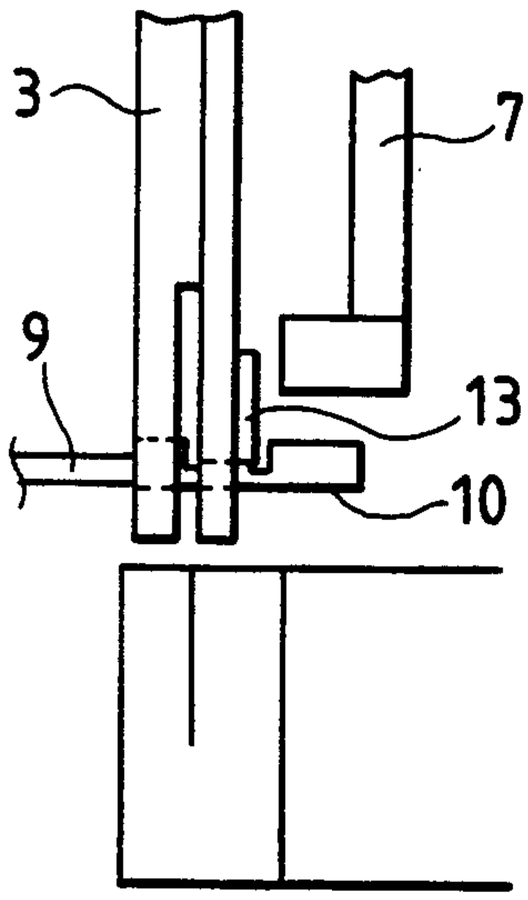


FIG. 4(b)

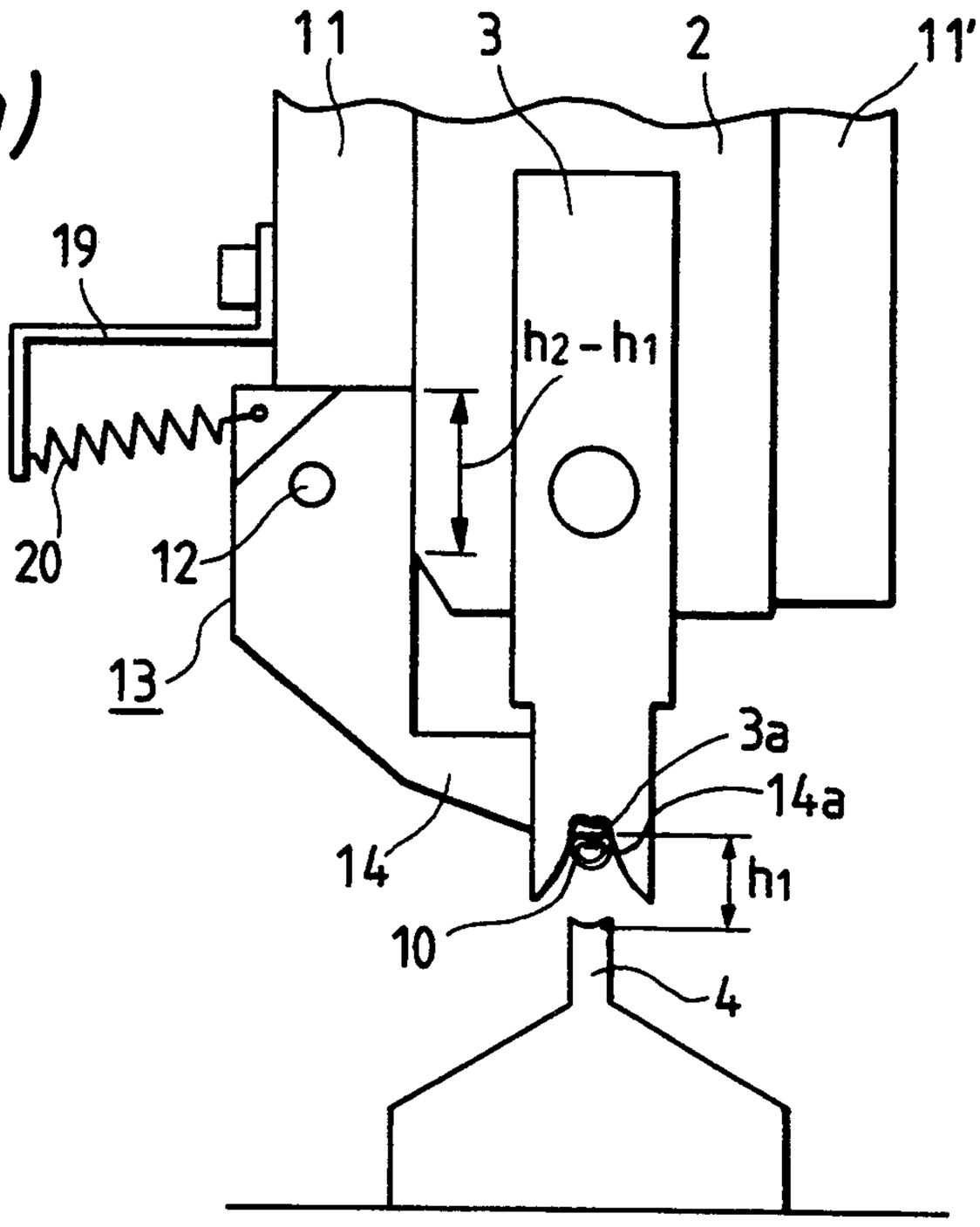


FIG. 5(a)

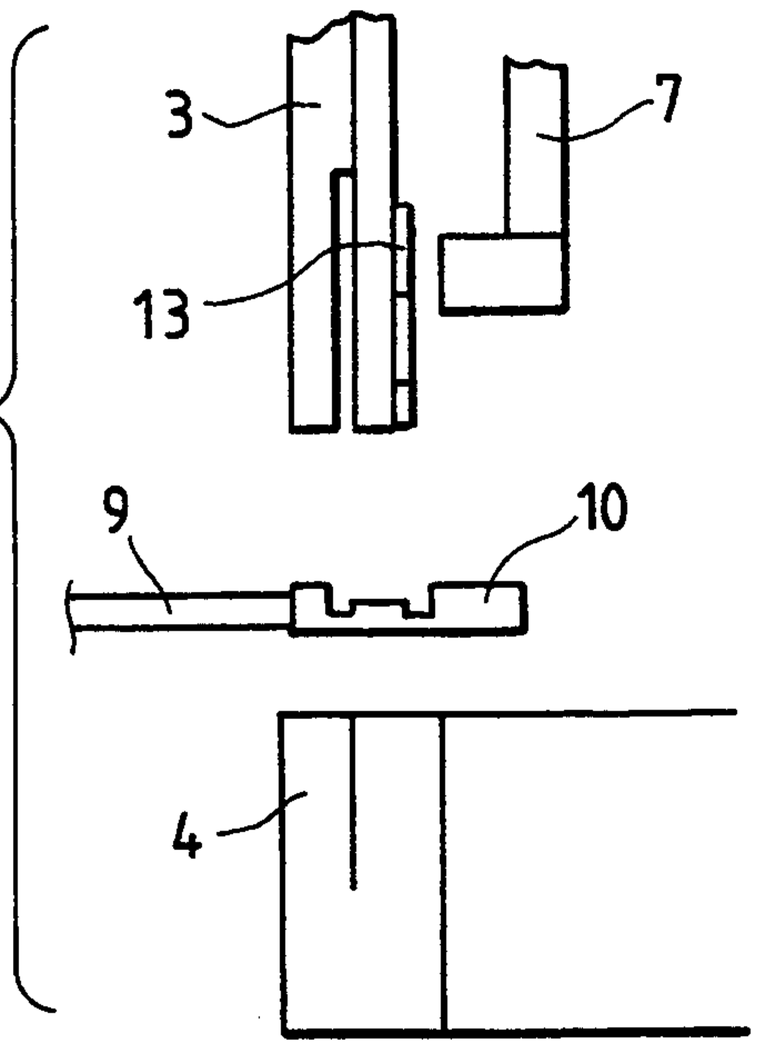


FIG. 5(b)

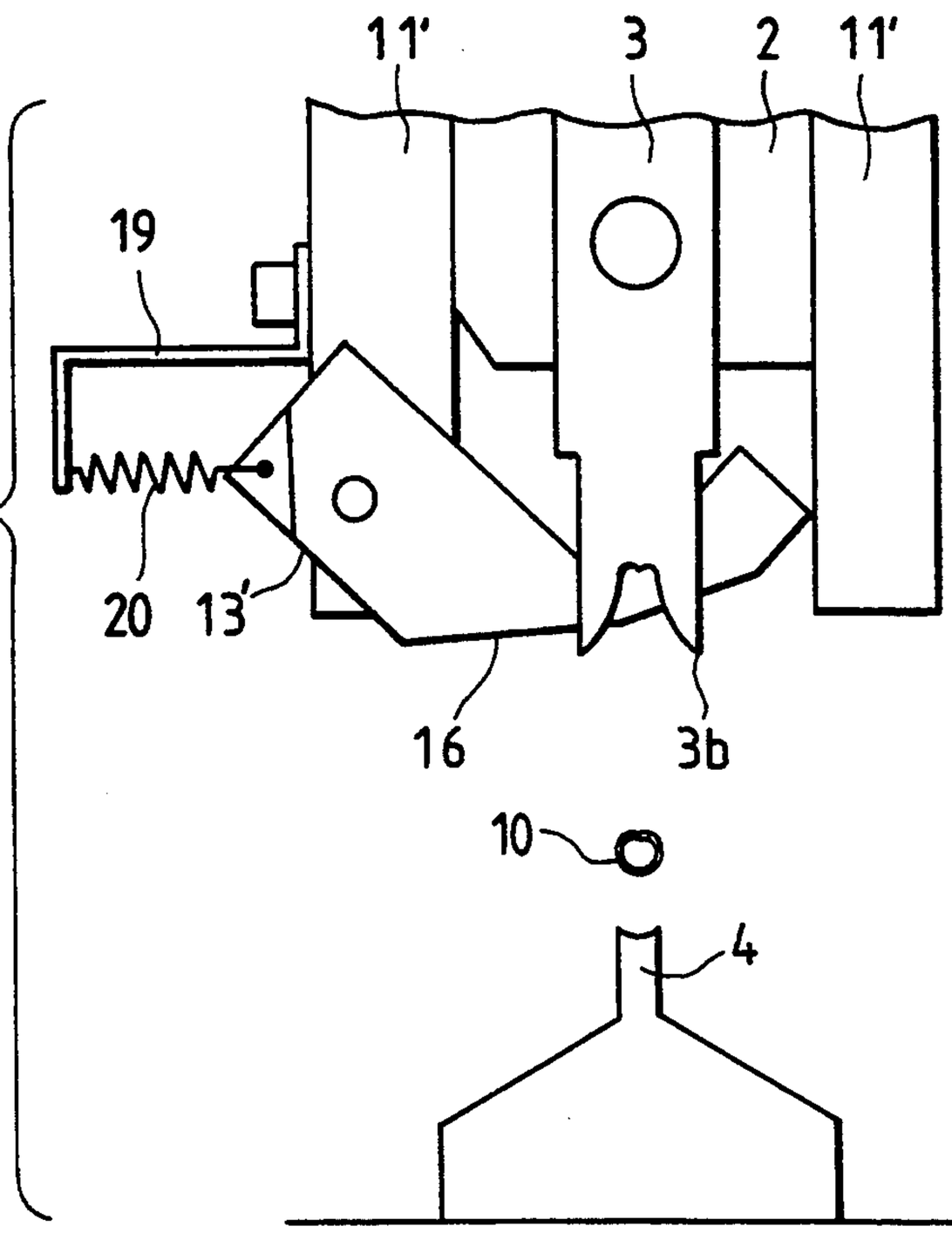


FIG. 6

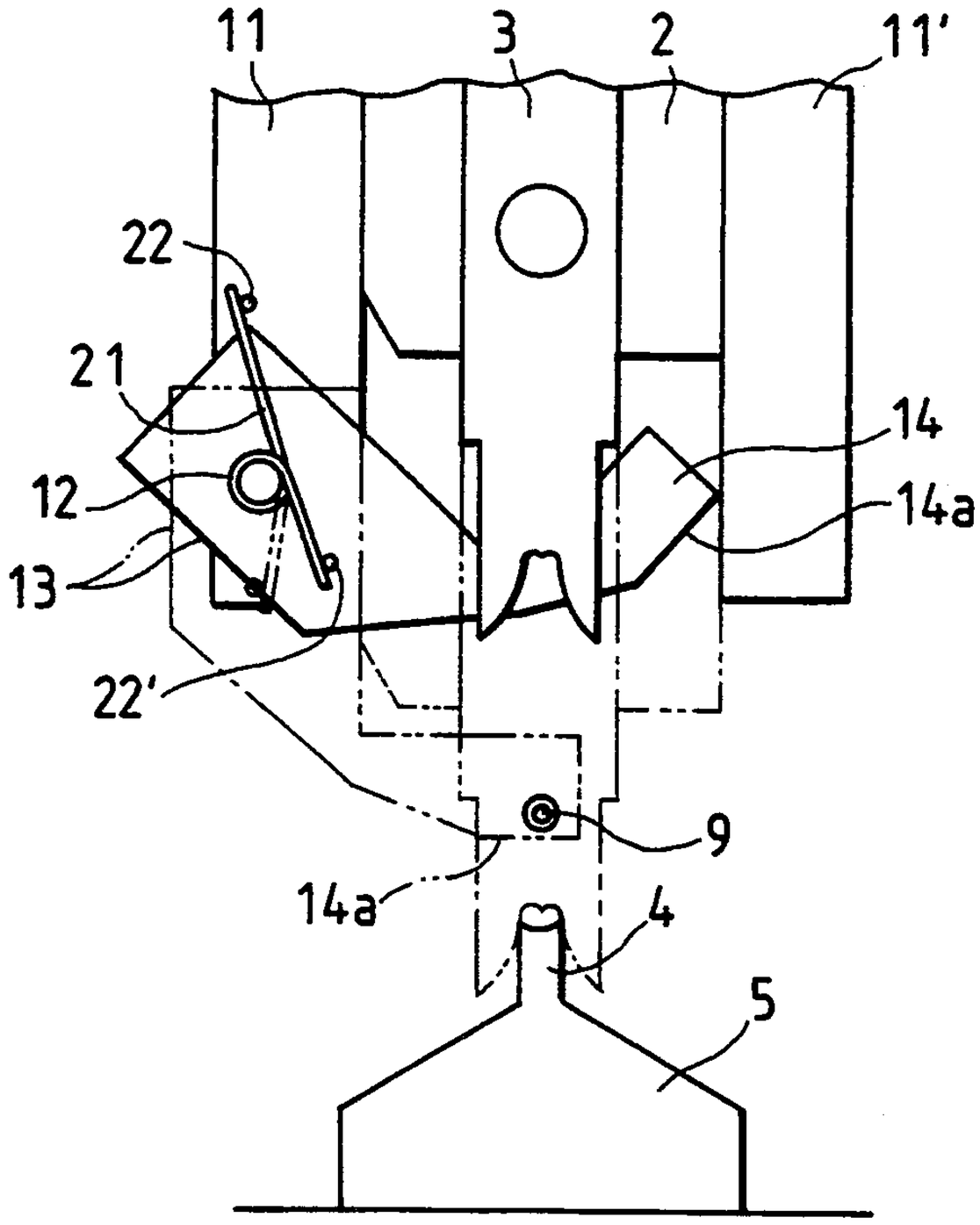


FIG. 7

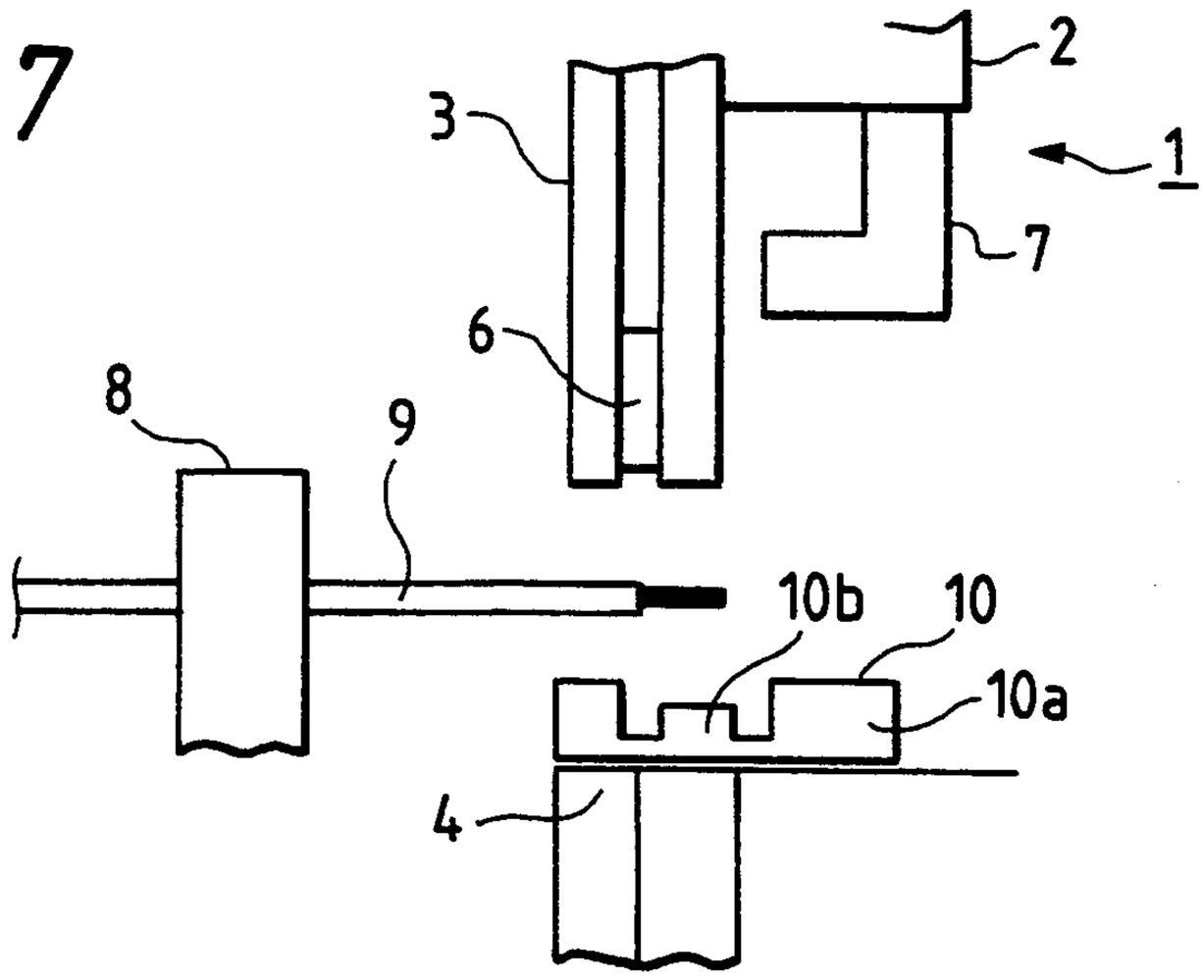


FIG. 8

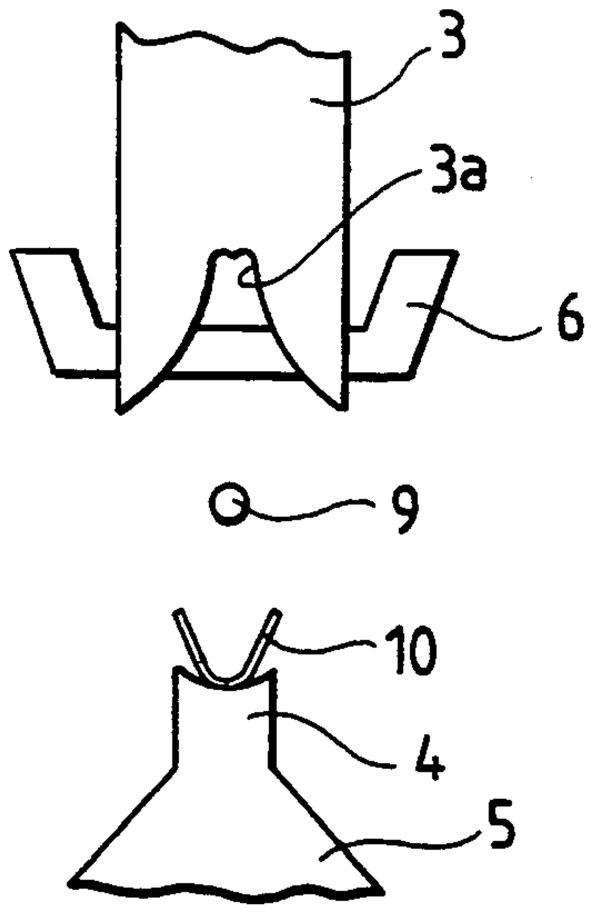


FIG. 9(a)

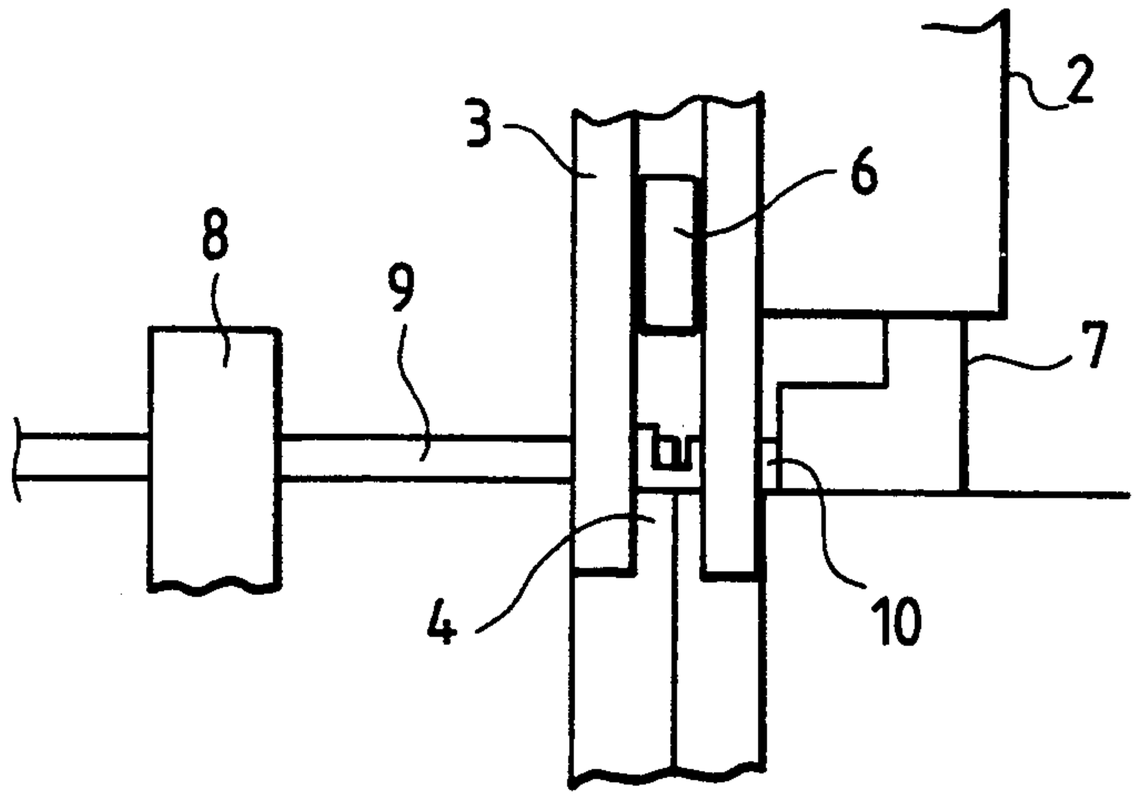


FIG. 9(b)

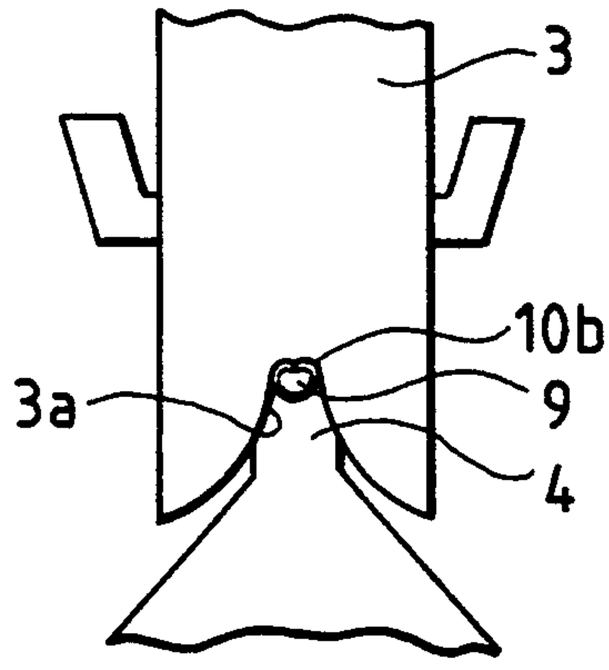


FIG. 10(a)

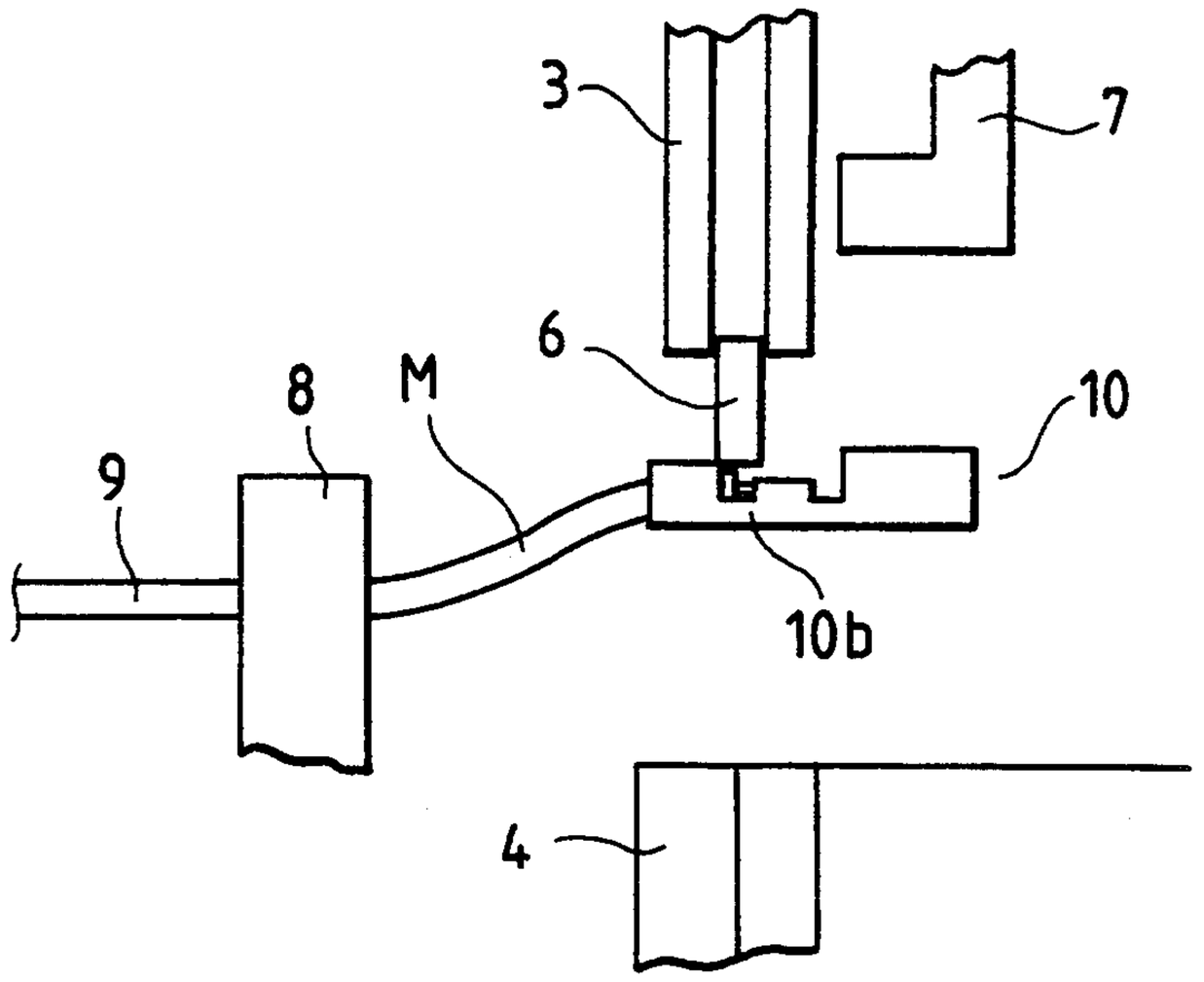


FIG. 10(b)

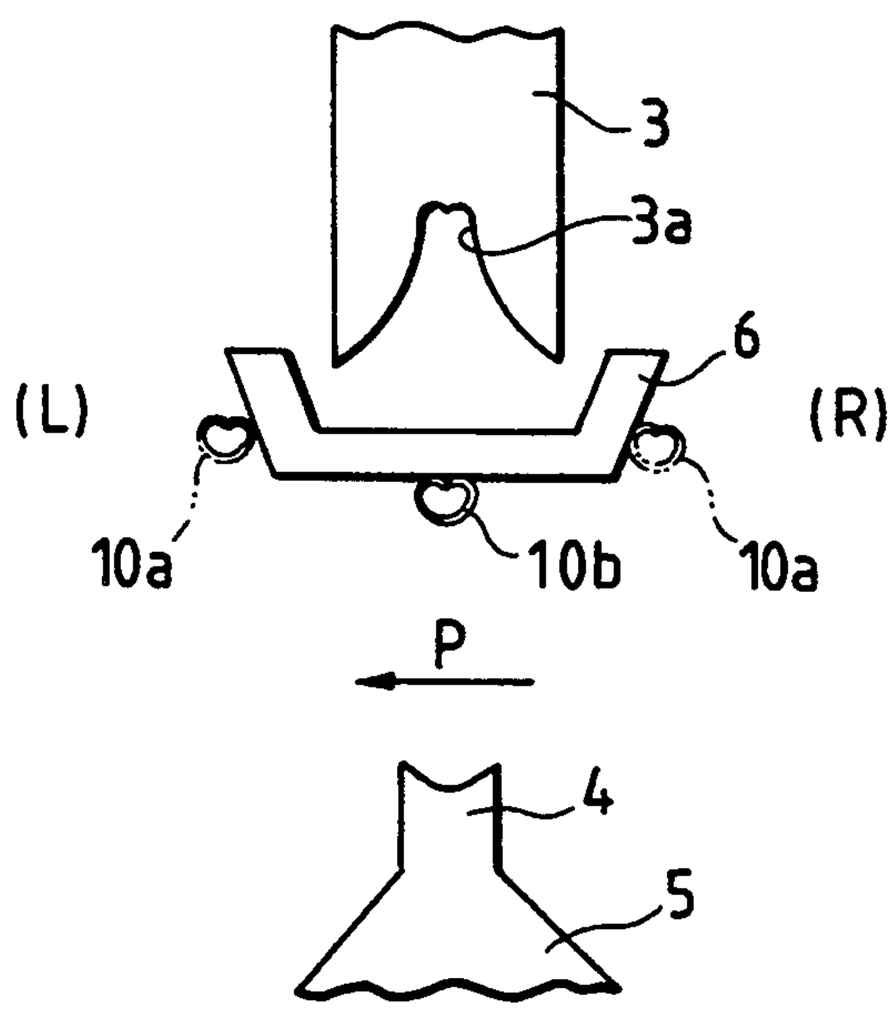
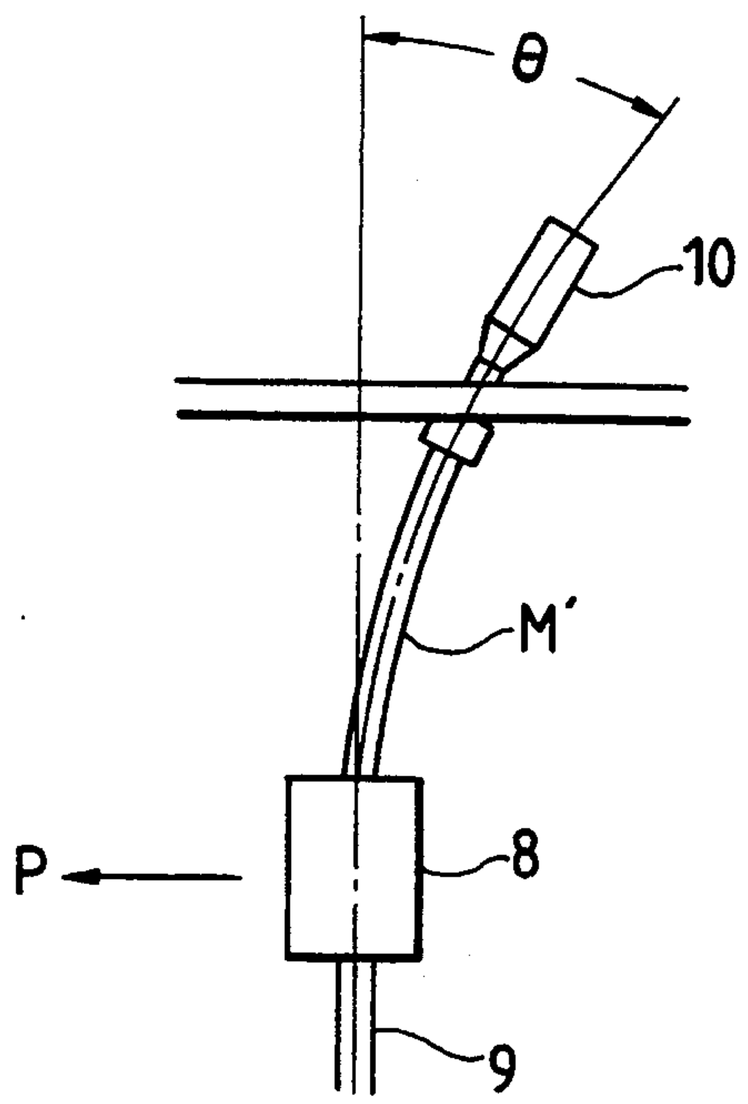


FIG. 11



TERMINAL CRIMPING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates generally to a terminal crimping machine for producing a cable integrated with a terminal to serve as a wire harness or the like. More particularly, the present invention relates to a terminal crimping machine of the foregoing type wherein the extent of bending of the cable after completion of a crimping operation is reduced as far as possible.

In FIG. 7 and FIG. **8**, reference numeral **1** designates a conventional terminal crimping machine. This conventional terminal crimping machine **1** includes a ram **2**, a crimper **3** adapted to be raised up and lowered together with the ram **2** fixedly secured to the crimper **2**, an anvil **4** located opposite to the crimper **3**, an anvil stand **5**, a stationary terminal releasing stopper **6**, and a terminal correcting guide **7**.

To crimp a cable **9** with a terminal **10**, first, the cable **9** is firmly held by a clamp **8** in the clamped state. While the foregoing state is maintained, the terminal **10** is then placed on the anvil **4** between the crimper **3** and the anvil **4**, and subsequently, as shown in FIG. **9**(A) and FIG. **9**(B), the ram **2** is lowered until the cable **9** is crimped with the terminal **10** between the crimper **3** and the anvil **4** in the clamped state (the lowering of the ram **2** may be accompanied by raising-up of the anvil **4**). When the terminal **10** assumes an inclined attitude relative to the cable **9**, the inclined state of the terminal **10** is corrected so as to allow the terminal **10** to linearly extend in the horizontal direction by depressing an electrical contact portion **10***a* of the terminal **10** with the terminal correcting guide **7** directly before the cable **9** is crimped by the crimper **3**.

After completion of the crimping operation, a cable connecting portion **10***b* of the terminal **10** is forcibly fitted into a recess portion **3***a* of the crimper **3** serving as a crimping surface. As shown in FIG. **10**(A) and FIG. **10**(B), as the terminal **10** is raised up together with the crimper **3**, it collides against the stopper **6**, causing the terminal **3** to be squeezed out of the recess portion **3***a* of the crimper **3** at the collision position.

As shown in FIG. **10**(A), when the terminal **10** is raised up while it is seized by the crimper **3**, bending M occurs with the cable **9**. Subsequently, when the cable **9** is disengaged from the crimper **3** due to collision of the cable **9** against the stopper **6**, it is reversely bent by the reactive power induced by the foregoing collision. Thus, there arises an occasion that the electrical contact portion **10***a* of the terminal **10** at the foremost end part of the latter is offset from the stopper **6** in the leftward direction or in the rightward direction as represented by phantom lines in FIG. **10**(B). In the case that the electrical contact portion **10***a* of the terminal **10** is offset on the opposite side (i.e., on the right-hand side as represented by R in the drawing) relative to the conveyance direction P of the clamp **8**, any significant problem does not appear. On the contrary, in the case that it is offset on the left-hand side L, i.e., in the same direction as the conveyance direction P of the clamp **8**, it interferes with the clamp **8** again as the latter is intermittently displaced, causing the cable **9** to be bent by a larger angle of θ in the rightward direction as shown in FIG. **11**. Thus, this bending M′ overlaps the bending M (as shown in FIG. **10**(A)), whereby the cable **9** and the terminal **10** are bent in the slantwise upward direction reverse to the conveyance direction P of the clamp **8**.

In the case that a terminal pass checker (not shown) is disposed at a predetermined position in the vicinity of the terminal crimping machine **1** in order to determine whether the cable **9** is correctly crimped in the terminal **10** by the crimper **3** or not, the terminal **10** interferes with the checker due to the bending represented by M and M′ before it reaches the predetermined detecting position. Thus, the terminal **10** is additionally bent without any possibility of checking the correctly crimped state of the cable **9**.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the aforementioned background and its object resides in providing a terminal crimping machine of the foregoing type which assures that a terminal and a cable are few bent after completion of a crimping operation without any possibility that the terminal interferes with a stopper during conveyance of the cable together with the terminal, and moreover, subsequent treatments such as checking of the correctly crimped cable, fitting of the cable into a case and so on can smoothly be achieved.

To accomplish the above object, the present invention provides a terminal crimping machine including a crimper vertically slidably fitted to a ram, an anvil located opposite to the ram, and a stopper adapted to come in contact with a cable to crimp the cable with the crimper in a terminal at the lower dead point of the ram while holding the cable between the crimper and the anvil, the stopper serving to disconnect the cable away from the crimper as the cable firmly fitted into the crimper and seized by the same is raised up, wherein the terminal crimping machine is characterized in that the stopper includes a terminal disconnecting piece and an arm piece for supporting the latter, the arm piece is turnably disposed on one of a pair of guide frames each serving to properly guide slidable raising/lowering of the ram, and moreover, biasing means for normally biasing the stopper to the crimper side is disposed on the stopper, that when the ram is lowered from the upper dead point to reach the lower dead point, the ram is slidably engaged with the arm piece of the stopper so as to allow the arm piece to assume an upright attitude, that while the ram is held at the lower dead point, the terminal disconnecting piece is located at the terminal disconnecting position higher than a crimping surface of the crimper by a predetermined distance, that when the crimping surface of the crimper is displaced to the position higher than the terminal disconnecting position, the arm piece is disengaged from the arm, causing the arm piece to be turned to the crimper side by the resilient power of the biasing means so as to assume an inclined attitude, and that when the ram reaches the upper dead point, an outer edge portion of the stopper is located inside of the lower end of the crimper.

When the crimper is raised up to reach the terminal disconnecting position higher than the crimping position by a predetermined distance while the terminal is firmly fitted into the crimper and seized by the same after completion of a crimping operation, the terminal collides against the terminal disconnecting piece of the stopper, causing the crimper to be disengaged from the terminal. This mode of operation is coincident with that of the conventional terminal crimping machine. According to the present invention, however, the stopper is turned to the crimper side by the resilient power of

the biasing means after the crimper reaches the upper dead point from the position slightly higher than the terminal disconnecting position, and while the crimper is held at the upper dead point, the outer edge portion of the stopper is retracted inside of the lower end of the crimper. Thus, any obstacle such as a conventional stationary stopper or the like is not present between the anvil and the stamper.

Thus, after completion of the crimping operation, the cable integrated with the terminal is conveyed between the anvil and the crimper without any interference with the stopper, whereby undesirable bending of the cable can be minimized, and moreover, any subsequent treatment can easily be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a terminal crimping machine constructed according to an embodiment of the present invention, particularly showing essential components constituting the terminal crimping machine.

FIG. **2** is a front view of the terminal crimping machine shown in FIG. **1**, particularly showing the arrangement of a crimper and an anvil.

FIG. **3**(A) is a fragmentary side view of the terminal crimping machine shown in FIG. **1** at the time of terminal crimping, and FIG. **3**(B) is a front view of the terminal crimping machine shown in FIG. **3**(B).

FIG. **4**(A) is a fragmentary side view of the terminal crimping machine when a crimper is raised up from a terminal crimping position by a predetermined length h_1, and FIG. **4**(B) is a front view of the terminal crimping machine shown in FIG. **4**(A).

FIG. **5**(A) is an illustrative view which shows that the crimper is raised up to reach the upper dead point, and FIG. **5**(B) is a front view of the terminal crimping machine shown in FIG. **5**(A).

FIG. **6** is a front view of a terminal crimping machine constructed according to another embodiment of the present invention, particularly showing the arrangement of a crimper and an anvil.

FIG. **7** is a side view of a conventional terminal crimping machine, particularly showing essential components constituting the conventional terminal crimping machine.

FIG. **8** is a front view of the conventional terminal crimping machine shown in FIG. **7**.

FIG. **9**(A) is a side view of the conventional terminal crimping machine shown in FIG. **8** at the time of terminal crimping, and FIG. **9**(B) is a front view of the conventional terminal crimping machine shown in FIG. **9**(A).

FIG. **10**(A) is a side view of the conventional terminal crimping machine, particularly showing the operative state that a terminal fitted into a crimper and raised up together with the crimper is disconnected from the crimper by a stopper, and FIG. **10**(B) is a fragmentary front view of the conventional terminal crimping machine.

FIG. **11** is an illustrative view which schematically shows that a cable integrated with a terminal is undesirably bent in the rightward direction.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described in detail hereinafter with reference to the accompanying drawings which illustrate a few preferred embodiments thereof.

FIG. **1** is a side view of a terminal crimping machine constructed according to an embodiment of the present invention, particularly showing essential components constituting the terminal crimping machine, and FIG. **2** is a fragmentary front view of the terminal crimping machine shown in FIG. **1**. Incidentally, same components as those constituting the conventional terminal crimping machine described above with reference to FIG. **7** to FIG. **11** are represented by same reference numerals.

Referring to FIG. **1** and FIG. **2**, a terminal crimping machine **1'** includes a pair of guide frames **11** and **11'** arranged on the opposite sides of a ram **2** for properly guiding slidable raising/lowering of the ram **2**, and a stopper **13** is pivotably disposed on one of the stoppers **11** and **11'**, i.e., the left-hand stopper **11** to pivot about a pin **12**. The stopper **13** is designed in the form of a L-shaped link composed of a terminal disconnecting piece **14** and an arm piece **15** for holding the latter, and the upper end part of the arm piece **15** is pivotably supported by the pin **12**. An outer edge portion **16** of the stopper **13** having the arm piece **15** and the terminal disconnecting piece **14** intersecting each other is tapered (or exhibits an arc-shaped contour).

A spring fixing piece **19** is secured to the guide frame **11** by tightening a bolt **18**, and a tension spring **20** serving as biasing means for biasing the stopper **13** to the crimper **13** side is bridged between the spring fixing piece **19** and a left-hand shoulder portion of the arm piece **15**.

Thus, the stopper **13** is normally biased by the resilient power of the tension spring **20** in such a manner as to pivot the stopper **13** about the pin **12** in the anticlockwise direction. With this construction, when the ram **22** is raised up to assume an upper dead position while it is disengaged from the stopper **13**, the arm piece **15** assumes an inclined attitude and the outer edge portion **16** of the arm piece **15** is located inside of a lower end **3***b* of the clipper **3**. On the contrary, when the ram **2** is lowered to come in slidable contact with an inner edge portion **15***a* of the arm piece **5** so that the arm piece **15** exhibits an upright attitude as represented by phantom lines, a lower end surface **14***a* of the terminal disconnecting piece **14** is located at the position directly above the anvil **4** (or a terminal **10**), i.e., at the terminal disconnecting position.

Next, a terminal crimping operation and an operation of the stopper **13** will be described below.

Referring to FIG. **1** and FIG. **2**, while a cable **9** is held by a clamp **8** in the clamped state, a terminal **10** is supplied to the space between the crimper **3** and the anvil **4** with the ram **2** located at the upper dead point. This state is coincident with that of the conventional terminal crimping machine with the exception that the stopper **13** assumes an inclined attitude by the resilient power of the tension spring **20**, and moreover, the outer edge portion **16** of the stopper **13** is located inside of the lower end **3***a* of the crimper **3**.

Subsequently, as shown in FIG. **3**(A) and FIG. **3**(B), as the crimper **3** is lowered, an electrical connecting portion **10***b* of the terminal **10** is compressed between the crimper **3** and the anvil **4**, whereby the cable **9** is firmly crimped by the crimper **3** in the terminal **10**.

When a taper portion **2***a* of the ram **2** at the lower end part of the latter comes in contact with an inner edge portion **15***a* of the arm piece **15** during the lowering movement of the crimper **3**, i.e., the ram **2**, the arm piece **15** of the stopper **13** held in the inclined state is

caused to turn about the pin **12** in the clockwise direction, and thereafter, a side edge portion **2***b* of the ram **2** comes in slidable contact with the inner edge portion **15***a* of the arm piece **15**, causing the arm piece **15** to assume an upright attitude. While the arm piece **15** assumes the upright attitude, a lower end surface **14***a* of the terminal disconnecting piece **14** is located at the terminal disconnecting position directly above the anvil **4** (or the crimping surface of the crimper **3**) with a predetermined height h_1 kept therebetween. This upright attitude is maintained until the ram **2** reaches the lower dead point, i.e., until the crimper **3** reach the crimping position. In the drawings, reference character h_2 designates a length of slidable displacement of the ram **2** and the stopper **13** or the range where they are slidably displaced. When the ram **2** is slidably displaced in the upward direction away from the foregoing range, the stopper **13** assumes the inclined attitude by the resilient power of the tension spring **20**.

When the crimper **3** (or the ram **2**) is raised up by the predetermined height h_1 after completion of the terminal crimping operation as shown in FIG. **4**(A) and FIG. **4**(B), the terminal **10** firmly fitted into and raised up by the crimper **3** collides against the lower end of the terminal disconnecting piece **14** at the terminal disconnecting position, causing the terminal **10** to be squeezed out of a recess portion (i.e., a crimping surface) **3***a* of the crimper **3** until it is disconnected therefrom.

As is apparent from FIG. **4**(B), when an inequality of $h_2 > h_1$ is established between h_2 and h_1, the stopper **12** can continuously assume the upright standing attitude no matter how far the crimper **3** is raised up.

When the crimper **3** (or the ram **2**) is raised up to reach an upper dead point as shown in FIG. **5**(A) and FIG. **5**(B) as it is raised up further, the terminal crimping machine is restored to original state shown in FIG. **1** and FIG. **2**. Specifically, the stopper **3** is turned in the clockwise direction by the resilient power of the tension spring **20** so that the outer edge portion **16** of the stopper **13** is completely retracted inside of the crimper **3**, resulting in an ample space being maintained between the crimper **3** and the anvil **4**. Thus, the terminal **10** or the cable **9** integrated with the latter is conveyed without any occurrence of interference with the stopper **13** regardless of slight bending of the terminal **10** or the cable **9** integrated with the latter.

In this embodiment, a quantity of bending of the cable **9** caused when the terminal **10** is raised up and fitted into the crimper **3** can be reduced by shortening the height h_1 of the terminal disconnecting piece **14** as measured from the anvil **4** when the arm piece **15** of the stopper **13** assumes an upright attitude, and moreover, allowing the terminal disconnecting position to approach the anvil **4** as far as possible. While the relationship between h_2 and h_1 as represented by an inequality of $h_2 > h_1$ is established therebetween, the distance between the crimper **3** located at the upper dead point and the anvil **2** may arbitrarily be determined without any restriction.

FIG. **6** shows by way of front view a terminal crimping machine constructed according to another embodiment of the present invention, particularly showing the structure of biasing means for a stopper **13**. In this embodiment, a twist spring **21** disposed around a pin **12** is substituted for the tension spring **20** in the preceding embodiment, and spring stop pins **22** and **22'** are attached to a frame **11** and an arm piece **15**. When a ram **2** is raised up to reach the upper dead point, a stopper **3** (i.e., an arm piece **15** of the same) assumes an inclined attitude, and when the ram **2** is lowered to assume the lower dead point, the stopper **3** assumes an upright attitude in the same manner as the preceding embodiment. Thus, repeated description on the foregoing facts will not be required. According to this embodiment, structural components such as a spring fixing piece or the like are not required. This makes it possible to construct the terminal crimping machine in a more simple manner.

With a terminal crimping machine constructed according to the present invention, a stopper including a terminal disconnecting piece and an arm piece integrated with the latter is substituted for a stationary terminal disconnecting stopper of the conventional terminal crimping machine, and the arm piece is turnably disposed on one of a pair of guide frames for properly guiding slidable raising/lowering of a ram. In addition, the terminal crimping machine includes biasing means for normally biasing the stopper toward the crimper side. Thus, when the ram is lowered from the upper dead point to reach the lower dead point, the arm piece assumes an upright attitude due to slidable contact of the ram with the arm piece of the stopper. While the ram is held at the lower dead point, the terminal disconnecting piece is located at the terminal disconnecting position higher than the crimping surface of the crimper by a predetermined distance, and subsequently, when the crimping surface of the crimper is upwardly displaced to the position higher than the terminal disconnecting position, the arm piece is disengaged from the ram so that it is turned to the crimper side by the resilient power of the biasing means to assume an inclined attitude. When the ram reaches the upper dead point, an outer edge portion of the stopper is located inside of the lower end of the crimper. With this construction, after completion of a crimping operation, since anything does not interfere with a terminal or a cable integrated with the latter between the crimper and the anvil, resulting in the cable being few bent. Consequently, any subsequent treatment can smoothly be achieved.

The foregoing description of preferred embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. The embodiments were chosen and described in order to explain the principles of the invention and its practical application to enable one skilled in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto, and their equivalents.

What is claimed is:

1. A terminal crimping machine comprising:

a guide frame;

a crimper secured to a ram and vertically moveable along said guide frame, said crimper having a crimping surface;

an anvil located opposite to said crimper, said anvil and said crimper cooperating to crimp a terminal to a cable when said ram and said crimper are moved to a lowermost position; and

a stopper for disconnecting said cable from said crimper as said cable, firmly fitted into said crimper, is raised up toward an uppermost position,

wherein said stopper includes a terminal disconnecting piece, an arm piece pivotably disposed on said guide frame for supporting the terminal disconnecting piece and biasing means for normally biasing said stopper,

wherein as said ram is lowered from the uppermost position to the lowermost position, said ram slidably engages said arm piece

so as to move said terminal disconnecting piece downwardly to a terminal disconnecting position located above the crimping surface of said crimper by a predetermined distance, and

wherein when said crimper is displaced to the position above the terminal disconnecting position, said arm piece is disengaged from said ram allowing said arm piece (**15**) to be pivoted to a non-interfering position so that when said ram reaches the uppermost position said terminal disconnecting piece is not disposed between said crimper and said anvil.

2. A terminal crimping machine according to claim **1**, in which said biasing means comprises a tension spring and a pin provided on the surface of said guide frame, said stopper being normally biased by the resilient power of said tension spring in such a manner as to pivot the stopper about said pin in the counterclockwise direction.

3. A terminal crimping machine according to claim **1**, in which said biasing means comprises:

a twist spring disposed around a pin provided on the surface of said one of guide frames; and

spring stop pins attached to said guide frame and said arm piece.

4. A terminal crimping apparatus for crimping a terminal to a cable, comprising:

a guide frame;

an anvil;

a crimper (**3**) disposed above said anvil and secured to a ram;

moving means for moving said ram, and attendantly said crimper, along said guide frame in a first direction from an uppermost position to a lowermost position at which said terminal is crimped between said crimper and said anvil so as to crimp said terminal to said cable, as a result of which said terminal is retained by said crimper; and

a stopper for disconnecting said terminal from said crimper as said crimper is moved in an opposite second direction, said stopper including a pivot arm having a terminal disconnecting portion which is rotatable from a first position to a second position at which said terminal abuts against said disconnecting portion when said crimper is moved in said second direction by a predetermined first distance, wherein movement of said terminal disconnecting portion from said first position to said second position is effected by movement of said crimper in said first direction.

5. The terminal crimping apparatus of claim **4**, wherein in said first position said terminal disconnecting portion is disposed above a lowermost portion of said crimper so as to not be disposed between said crimper and said anvil.

6. The terminal crimping apparatus of claim **5**, further comprising biasing means for rotating said pivot arm such that said terminal disconnecting portion is disposed in said first position, said rotation to said first position being effected after said ram moves in said second direction by a predetermined second distance which is greater than said predetermined first distance.

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